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K.C.S.E. CHEMISTRY PAPER 233/2 2006

1. (a) What is an electrolyte? (1 mark)

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.....

(b) State how the following substances conduct electricity:

(i) molten calcium chloride (1 mark)

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(ii) graphite. (1 mark)

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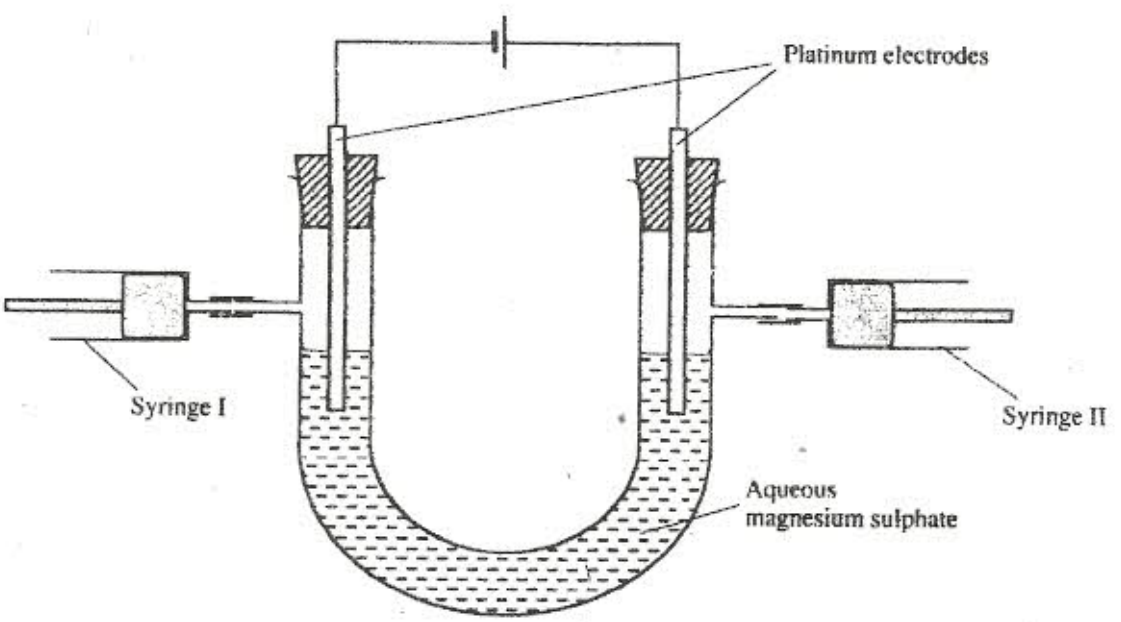
(c) The diagram below shows a set up that was used to electrolyse aqueous magnesium sulphate.



(i) On the diagram above, using an arrow, show the direction of flow of electrons. (1 mark)

(ii) Identify the syringe in which hydrogen gas would be collected. Explain. (1 mark)

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.....

(d) Explain why the concentration of magnesium sulphate was found to have increased at the end of the experiment. (2 marks)

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(e) During the electrolysis, a current of 0.72A was passed through the electrolyte for 15 minutes. Calculate the volume of gas produced at the anode. (1 Faraday = 96 500 coulombs; molar gas volume is 24000 cm^3 at room temperature). (4 marks)

.....

.....

2. (a) In an experiment to determine the molar heat of reaction when magnesium displaces copper, 0.15g of magnesium powder were added to 25.0cm^3 of 2.0M copper (II) chloride solution. The temperature of copper (II) chloride solution was 25°C. while that of the mixture was 43°C.

(i) Other than increase in temperature, state and explain the observations which were made during the reaction. (3 marks)

.....

.....

(ii) Calculate the heat change during the reaction (Specific heat capacity of the solution = 4.2$jg^{-1}K^{-1}$ and the density of the solution = 1g/cm^3). (2 marks)

.....

.....

(iii) Determine the molar heat of displacement of copper by magnesium. (Mg = 24.0). (2 marks)

.....

.....

(iv) Write the ionic equation for the reaction. (1 mark)

.....

.....

(v) Sketch an energy level diagram for the reaction. (2 marks)

(b) Use the reduction potentials given below to explain why a solution containing copper ions should not be stored in a container made of zinc.

$Zn^{2+}_{(aq)} + 2e \rightarrow Zn_{(s)}$; $E^{\theta} = -0.76V$

$Cu^{2+}_{(aq)} + 2e \rightarrow Cu_{(s)}$; $E^{\theta} = +0.34V$ (2 marks)

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3. (a) Distinguish between isotopes and allotropes. (2 marks)

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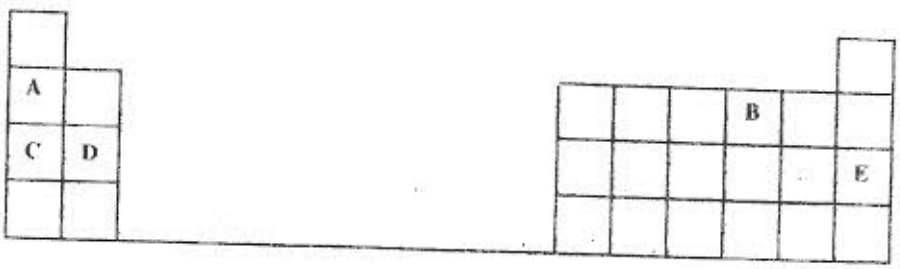
(b) The chart below is part of the periodic table. Study it and answer the questions that follow. (The letters are not the actual symbols of the elements).



(i) Select the element in period three which has the shortest atomic radius. Give a reason for your answer. (2 marks)

.....

.....

(ii) Element F has the electronic structure, 2.8.18.4. On the chart above, indicate the position of element F. (1 mark)

(iii) State one use of the elements of which E is a member. (1 mark)

.....

(iv) Write an equation to show the action of heat on the nitrate of element C. (1 mark)

.....

(c) When 3 litres of chlorine gas were completely reacted with element D, 11.875g of the product were formed. Determine the relative atomic mass of element D. (Atomic mass of chlorine = 35.5; molar gas volume = 24 litres). (3 marks)

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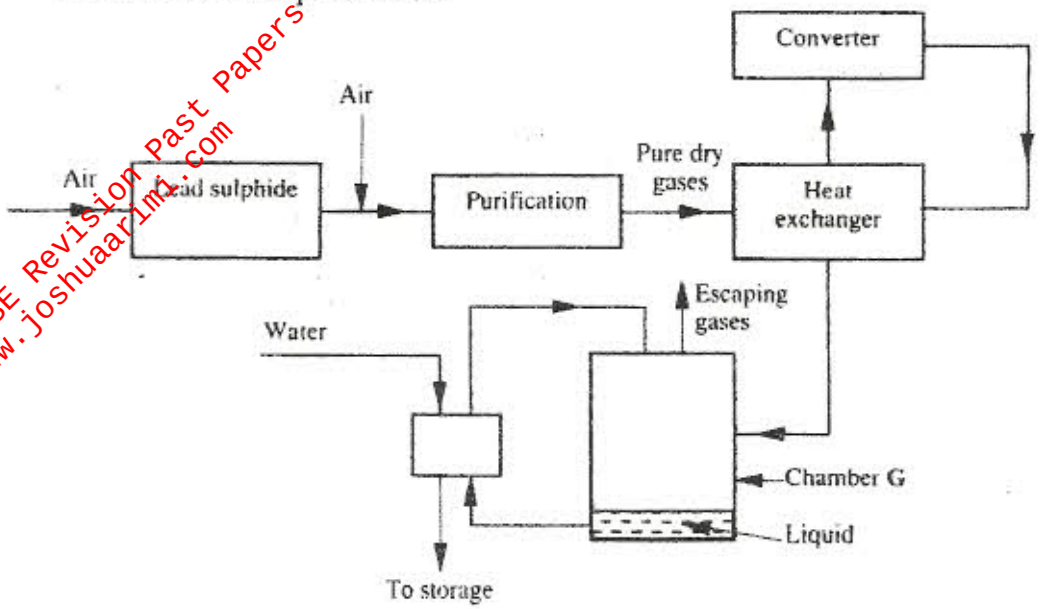
4. (a) The diagram below shows some processes that take place during the industrial manufacture of sulphuric acid.



(i) Write the equation for the reaction in which sulphur dioxide gas is produced. (1 mark)

.....

(ii) Why is it necessary to keep the gases pure and dry? (1 mark)

.....

.....

(iii) Describe the process that takes place in chamber G. (1 mark)

.....

(iv) Name the gases that escape into the environment. (1 mark)

.....

.....

(v) State and explain the harmful effect on the environment of one of the gases named in (iv) above. (1 mark)

.....

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(vi) Give **one** reason why it is necessary to use a pressure of 2 -3 atmospheres and not more. (1 mark)

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(b) (i) Complete the table below to show the observations made when concentrated sulphuric acid is added to the substances shown. (2 marks)

Substance	Observation
Iron filings	
Crystals of white sugar	

(ii) Give reasons for the observations made using:

I iron filings (1 mark)

.....

II crystals of white sugar. (1 mark)

.....

(c) Name one fertilizer made from sulphuric acid. (1 mark)

.....

(d) Suggest a reason why $BaSO_4$ (A pigment made from sulphuric acid) would be suitable in making paint for cars. (1 mark)

.....

5. (a) What name is given to a compound that contains carbon and hydrogen only? ($^1/_2$ mark)

.....

(b) Hexane is a compound containing carbon and hydrogen.

(i) What method is used to obtain hexane from crude oil? (1 mark)

.....

(ii) State one use of hexane. (1 mark)

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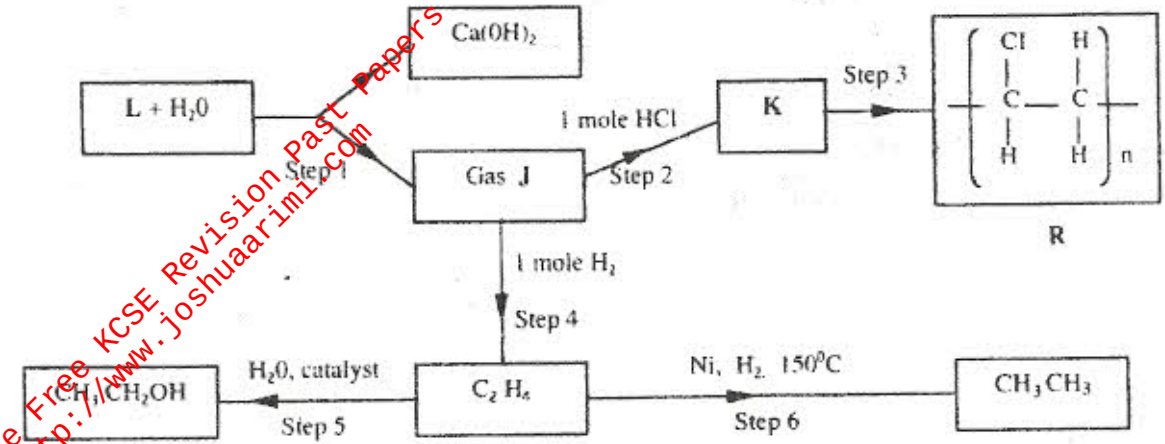
(c) Study the flow chart below and answer the questions that follow.



(i) Identify reagent **L**. (1 mark)

.....

(ii) Name the catalyst used in Step 5. (1 mark)

.....

(iii) Draw the structural formula of gas **J**. (1 mark)

.....

.....

(iv) What name is given to the process that takes place in step 5? ($\frac{1}{2}$ mark)

.....

(v) State:

I **one** use of product **R** (1 mark)

.....

.....

II a commercial application of the process which takes place in step 6. (1 mark)

.....

(d) (i) Write the equation for the reaction between aqueous sodium hydroxide and aqueous ethanoic acid. (1 mark)

.....

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(ii) Explain why the reaction between 1g of sodium carbonate and 2M hydrochloric acid is faster than the reaction between 1g of sodium carbonate and 2M ethanoic acid. (2 marks)

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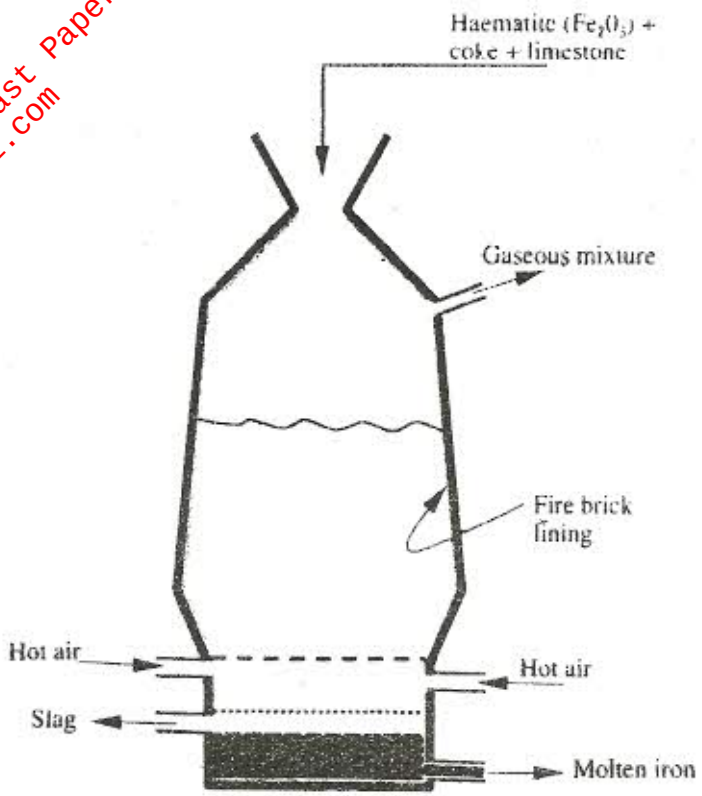
6 The extraction of iron from its ores takes place in the blast furnace. Below is a simplified diagram of a blast furnace. Study it and answer the questions that follow.



(a) Name:

(i) **one** of the substances in the slag (1 mark)

.....

(ii) another iron ore material used in the blast furnace (1 mark)

.....

(iii) **one** gas which is recycled. (1 mark)

.....

(b) Describe the processes which lead to the formation of iron in the blast furnace. (3 marks)

.....

.....

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(c) State the purpose of limestone in the blast furnace. (1 mark)

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(d) Give a reason why the melting point of the iron obtained from the blast furnace is 1200°C while that of pure iron is 1535°C. (1 mark)

.....

(e) State **two** uses of steel. (2 marks)

.....

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7. The table below shows the volumes of nitrogen dioxide gas produced when different volumes of 1M nitric acid were each reacted with 2.07g of lead at room temperature.

Volume of 1M nitric acid (cm^3)	Volume of nitrogen dioxide gas (cm^3)
5	60
15	180
25	300
35	420
45	480
55	480

(a) Give a reason why nitric acid is not used to prepare hydrogen gas. (1 mark)

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(b) Explain how the rate of the reaction between lead and nitric acid would be affected if the temperature of the reaction mixture was raised. (2 marks)

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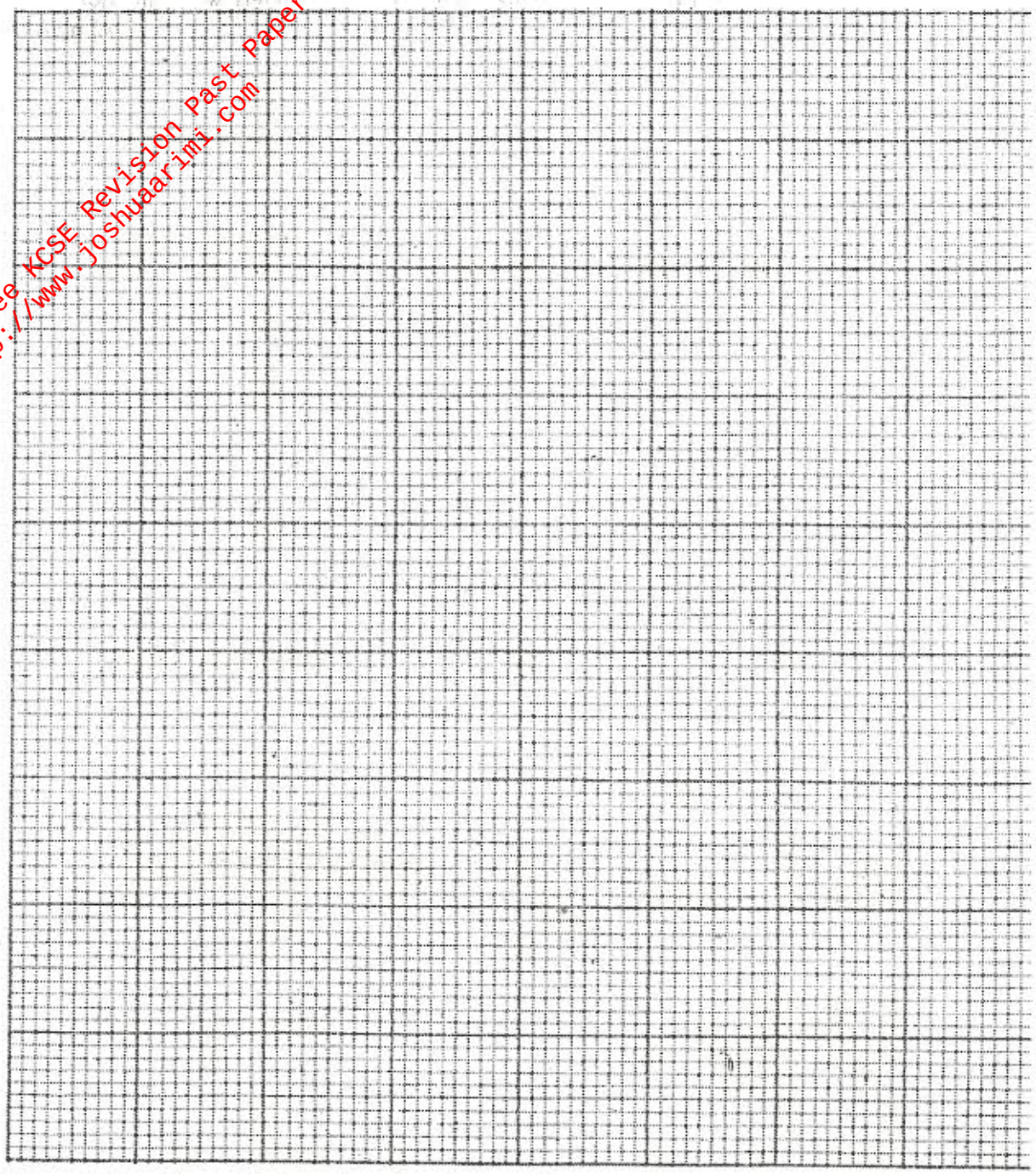
(c) On the grid provided below, plot a graph of the volume of the gas produced (vertical axis) against volume of acid. (3 marks)



(d) Using the graph, determine the volume of:

(i) nitrogen dioxide produced when $30cm^3$ of 1M nitric acid were reacted with 2.07g of lead (1 mark)

.....

(ii) 1M nitric acid which would react completely with 2.07g of lead. (1 mark)

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(e) Using the answer in d(ii) above, determine:

(i) the volume of IM nitric acid that would react completely with one mole of lead (Pb = 207) (2 marks)

.....

.....

(ii) the volume of nitrogen dioxide gas produced when one mole of lead reacts with excess IM nitric acid at room temperature. (1 mark)

.....

.....

(f) Calculate the number of moles of :

(i) IM nitric acid that reacted with one mole of lead (1 mark)

.....

.....

(ii) nitrogen dioxide produced when one mole of lead were reacted with excess nitric acid. (Molar gas volume is 24000 cm^3). (1 mark)

.....

.....

(g) Using the answers obtained in f(i) and (ii) above, write the equation for the reaction between lead and nitric acid given that one mole of lead nitrate and two moles of water were also produced. (1 mark)

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